Graphical Methods in Nautical Astronomy.

As the author of the article in Nature of October 24, 1918, in which the diagram referred to by Dr. Hutchinson last week was first brought to the notice of your readers, may I be permitted to supplement the information as to previous efforts in the same direction? When the diagram first appeared in this country Rear-Admiral Parry, Hydrographer to the Admiralty, also set on foot an inquiry similar to that of Dr. Hutchinson, and very courteously sent me the result of his investigation. From his report it appears that "an account of the 'Nomogramme' was published in *Petermann's Mittelungen* (vol. ii., pp. 182 and 249, 1913), and was illustrated by a skeleton diagram similar in principle to these charts, and the method for using it was fully explained." This, in point of time, is fifteen years later than the date of the paper of M. d'Ocagne, who, so far as appears at present, is clearly entitled to the credit claimed for him as first in the field.

The share of Mr. Littlehales, however, is marked by two features of interest:—(1) That he seems to have been the first to prepare and publish the diagram in a form that promises to be useful in the navigation of air and ocean, and (2) that the simplicity of treatment which deduces the principle and graduation of the chart directly from a general formula of spherical trigonometry renders the theory of the matter intelligible to many nautical persons to whom the mysteries of "Nomographie" are as a sealed book. H. B. Goodwin.

March 15.

The Oldest Mosquitoes.

The Rev. Peter Bellinger Brodie, in his "History of the Fossil Insects of the Secondary Rocks of England," gave a figure of a small fly which he named *Culex* (?) *fossilis*. This insect, from the Purbeck strata, would be by far the oldest mosquito known, were it a veritable Culex. Unfortunately, it is impossible to form any definite opinion, and as positive evidence of the antiquity of the Culicidæ the specimen must be dismissed as valueless. On general grounds it is very improbable that the group is so ancient. In Handlirsch's great work on fossil insects several Culicidæ are listed from the Oligocene Tertiary; but Handlirsch did not know that two species described by Scudder, from Wyoming and Utah respectively, are actually much older, coming from Eocene rocks. The one from Utah is of little value, and presumably not a true Culex; but that from the Green River beds of Wyoming has the unmistakable features of a genuine mosquito, showing the long proboscis and the short palpi of the female. According to Schuchert's estimates of geologic time, this should be more than two million years old at the very least. Scudder's insect, called *Culex damnatorum*, is 6 mm. long, with a proboscis 1·9 mm. It doubtless tormented the Eohippus and related mammals of this general period. Whether it carried any pathogenic protozoa we can, of course, never know. It is now possible to put on record a second Eocene mosquito, found by Mr. Dean E. Winchester, of the U.S. Geological Survey, at Smith's Ranch, in the vicinity of the Cathedral Bluffs, in western Colorado. It is represented by a female, preserved in lateral view, 5·2 mm. long, the wing about 4·2 mm., thorax about 2 mm., palpi about 0·4 mm., and the distinctly curved proboscis 3 mm. The stout abdomen is like that of true Culex, obtuse at the end, not tapering as in Aëdes. The longer proboscis readily separates it from Scudder's insect, so it must stand as a new species, to be called *Culex winchesteri*, after its discoverer. The horizon is considered to be Green River, approximately equivalent to that of the Wyoming locality.

The oldest British mosquitoes, setting aside Brodie's very dubious Purbeck specimen, are three species from the Oligocene of Gurnard Bay, in the Isle of Wight, also collected by Brodie. These were described by the present writer in 1915, and are in the U.S. National Museum. One of them is so beautifully preserved that it shows the wing-scales.

While writing on fossil Diptera I take occasion to note that my *Mesomyites concinnus*, another of the Gurnet Bay fossils, is evidently a member of the peculiar Tipulid genus Styringomyia, and should be called *Styringomyia concinna*. I am indebted to Mr. C. P. Alexander for suggesting the correction. The specimen is in the British Museum.

The Gurnard Bay locality, which furnished Brodie with large and important collections, seems not to have been investigated in recent years. Most of Brodie's collection is at the British Museum, and will, when fully described, add greatly to our knowledge of Tertiary insects. T. D. A. Cockerell.

University of Colorado, Boulder, Colorado.

Proposed Magnetic and Allied Observations during the Total Solar Eclipse of May 29, 1919.

Special magnetic and allied observations will be made at certain stations inside and outside the shadow belt of the total solar eclipse of May 29 next by the Department of Terrestrial Magnetism of the Carnegie Institution of Washington and by various magnetic observatories, institutions, and individuals. The probable stations of the Department of Terrestrial Magnetism are (1) La Paz, Bolivia; (2) Huancayo (north of belt of totality); (3) near Sobral, Brazil; (4) Ile Principe or Libreville, French Congo; and (5) various field stations within the zone of visibility. At station (3) complete magnetic and electric observations will be made.

The general scheme of work proposed by the Department of Terrestrial Magnetism is as follows:—

(1) *Simultaneous magnetic observations* of any or all of the elements, according to the instruments at the observer's disposal, every minute from May 29 next, 9h. 58m. a.m. to 4h. 32m. p.m. Greenwich civil mean time, or from May 28, 21h. 58m. to 4h. 32m. May 29, Greenwich astronomical mean time.

(To ensure the highest degree of accuracy, the observer should begin to work early enough to have everything in complete readiness in proper time. Past experience has shown it to be essential that the same observer should make the readings throughout the entire interval. If possible, similar observations for the same interval of time as on May 29 should be made on May 28 and 30, to afford some means of determining the undisturbed course of the magnetic declination.)

(2) *At magnetic observatories* all necessary precautions should be taken to ensure that the self-recording instruments will be in good operation, not only during the proposed interval, but also for some time before and after, and eye-readings should be taken in addition wherever it is possible and convenient.

(It is recommended that, in general, the magnetograph should be run on the usual speed throughout the interval, and that, if a change in recording speed be made, every precaution possible should be taken to guard against instrumental changes likely to affect the continuity of the base line.)

(3) *Atmospheric-electric observations* should be made to the extent possible with the observer's equip-

©1919 Nature Publishing Group

ment and *personnel* at his disposal. At least observations of potential-gradient and conductivity (preferably both positive and negative) should be made.

(4) *Meteorological observations* in accordance with the observer's equipment should be made at convenient periods (as short as possible) throughout the interval. It is suggested that at least temperature should be read every fifth minute (directly after the magnetic reading for that minute).

(5) *Observers in the belt of totality* are requested to take the magnetic reading every thirty seconds during the interval, ten minutes before and ten minutes after the time of totality, and to read temperature also every thirty seconds before the magnetic readings.

It is hoped that full reports will be forwarded as soon as possible for publication in the journal *Terrestrial Magnetism and Atmospheric Electricity*. Those interested are referred to the results of the observations made during the solar eclipse of June 8, 1918, the publication of which was begun in the September (1918) issue of the journal. A summary of the results obtained is given in the March (1919) issue. LOUIS A. BAUER.

Carnegie Institution of Washington, Department of Terrestrial Magnetism, Washington, D.C., February 15.

A Proof that any Aggregate can be Well-ordered.

ALL the critics of my method sketched or described in my two letters to NATURE (vol. ci., pp. 84 and 304, 1918), in my two notes in *Comptes rendus* (vol. clxvi., pp. 520–23 and 984–86, 1918), in *Mind* for July, 1918, and in *Science Progress* for October, 1918, wish to see a certain particular case solved in detail. Although this case does not throw so much light on the problem as the equally simple method of dealing with the general case, which I happen to have discovered long before I applied it to special cases, I here give the treatment of the particular case referred to.

Suppose that an aggregate M is such that there are classes x_1, x_2 . . ., where x_n is the class of all those chains of M of type n, and the suffixes of the x's are all the finite ordinal numbers (that is, those less than ω); we are to prove that M has a chain of type ω. We will define by complete induction a rule for actually constructing out of the x's *many* (we can prove afterwards that the *many* are *all*; we do not, of course, merely postulate that there is a non-null class of all such classes) classes of direct continuations of which each contains one chain from each x. The rule, though it is, accordingly, split into two parts, is to be regarded as one whole; and it can be so regarded, since it does not involve an infinity of arbitrary selections.

(1) With each member K_2 of x_2, class that member of x_1 which is the sole segment of K_2. Thus each member of x_1 is classed with many of x_2, and each member of x_2 is classed with a definite one of x_1 so that together these members form a class of direct continuations with members of types 1 and 2.

(2) In general, for $2<n<\omega$, with each member K_n of x_n classify (*a*) that member (K_{n-1}) of x_{n-1} which is a segment of K_n, and (*b*) also those chains of types $n-2$, . . . 2, 1 previously classed with K_{n-1} by the rule. Remember not to regard here a class of y and z as anything more than just y and z. For instance, each member of x_3 forms, with the chains classed with it, a class of direct continuation with three members; and we easily see that, in general, every class of direct continuations with n members is added to, provided that the whole rule is applied and not merely a part of it which stops at n.

Thus we have defined a means of rearranging all the members of all the x's so that they form classes of direct continuations of the kind we wished and stated above. Since any class of *direct continuations* which is formed from the members of M, and contains chains of all types less than ω, plainly defines a chain of type ω, each of the classes of direct continuations formed by the rule defines a chain of type ω. This is what we had to prove. We have, indeed, a set of classes of direct continuations such that each class has at least two terms, and, if it has n terms, it has $n+1$. PHILIP E. B. JOURDAIN.

The Bourne, Basingbourne Road,
Fleet, Hants, March 11.

Coal in Thrace.

ANTIGONOS, a Greek writer about the beginning of our era, made a collection of the accounts of the natural wonders of his time. Among them he mentions—I translate from the Greek edition of 1568—that "they say that in the wild (uncultivated) region of Thrace there is a river called Pontos, which brings down in its course stones resembling *anthrax* (charcoal), and that these burn, but differ in combustion from charcoal, inasmuch as the use of bellows extinguishes the fire. On the other hand, sprinkled with water they burn all the better." Where was this river? Kiepert does not mention it, but it seems to have flowed into the Black Sea, then called Pontos. It would be interesting to know if anthracite has been found so near Constantinople.

EDMUND M'CLURE.

80 Eccleston Square, S.W.1, February 27.

THERE is no warranty for suggesting that "stones resembling anthrax" are anthracite; they are far more likely to have been bituminous coal or lignite, both of which burn more readily than does anthracite, which latter is decidedly difficult of ignition. Whilst European Turkey has not been fully explored for coal, the existence of coal is known in various places; a bituminous coal-seam is reported near Keshan, in the province of Adrianople, and along parts of the northern coast of the Sea of Marmora; and there are lignite deposits known near Rodosto, near Dedeagatch, and even within a short distance of Constantinople. Obviously any of these deposits might have given rise to the stones referred to by Canon M'Clure.

It would be interesting to know whether the Greek text excludes the possibility of its reference being to the district of Pontos, on the south shores of the Black Sea, as the best-known coal-mines of all the region are those to the south of Heraclea in that district. HENRY LOUIS.

Armstrong College, Newcastle-upon-Tyne,
March 3.

Curious Markings on Chalk.

DR. ANDREWS (NATURE, March 13, p. 25) probably knows more about the natural forms assumed by chalk than I do, but I think, nevertheless, that the specimen described by me in the February issue of *Man* (p. 17, pl. B) cannot be disposed of quite so summarily as he supposes. And I would suggest that it is generally considered unwise, in such matters, to publish a definite opinion before an examination of the actual specimen has been made.

It is my hope that before long Mr. Gathorne-Hardy may exhibit his discovery at a meeting of

©1919 Nature Publishing Group